Code 582

Flight Software Branch

[Mission Name (Mission Acronym)]

FSW CONFIGURATION MANAGEMENT PLAN

Flight Software Branch – Code 582

Template Version 1.0 – 04/25/05

582-2003-002

(Replace with Mission Configuration Management Plan Version)

Goddard Space Flight Center

Greenbelt, Maryland

National Aeronautics and
Space Administration

FORWARD

This document is the Configuration Management Plan Template intended for use by Code 582 (Flight Software Branch) personnel as the basis for a mission-specific Flight Software Configuration Management Plan.

The following style conventions are used throughout:

Text in this style (style name "BODY") is used for text that is equally applicable to all Configuration Management Plans and should be included in the Configuration Management Plan without modification. All document section headings are in the same category; although, their style names vary depending on outline level.

[Text in this style (style name "TAILORING ADVICE") is advice on how to tailor the text in any specific section.]

As the plan is developed, the generic [TAILORING ADVICE] text should be replaced with material that applies to the specific project.

GENERAL TAILORING GUIDELINES

This section includes general tailoring guidelines applicable to the whole document. Specific recommendations are included in applicable sections.

All components of the table of contents should be addressed, but the level of detail is left up to the Team based on flight software system complexity and customer needs/expectations. Section headings may be added where necessary, but existing headings should not be modified or deleted. If a particular section is not applicable to the specific Configuration Management Plan under production, that fact should be noted under the section heading, together with a brief explanation.

The following disclaimer appears on all pages: "Printed copies of this document are for REFERENCE PURPOSES ONLY! The only controlled copy of this document is located on-line at http://xxxxxxxx". This disclaimer should be modified to contain the appropriate URL, but should not be removed.

Finally, in the target Plan, this entire section ("Forward") can be deleted or replaced with product-specific information.

SIGNATURES

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PLAN UPDATE HISTORY

Version	Date	Description	Affected Pages
0.1	01/16/03	Draft in progress – skeleton document created from New Millenium Program Space Technology 5 Flight Software and Database Configuration Management Plan, ST5-FSW-053, Revision 1.1.	All
0.2	07/23/03	New cover page, new URL in footer, no other changes.	All
0.3	11/12/03	Changes from 11/10 walkthrough	Section 5
0.4	05/17/04	Changes from inputs received from team reviewers, project team leads. Changes incorporated from teleconferences regarding DCR processes and states as well as overall CM processes and functions.	All
0.5	09/31/04	Incorporated DCR state and process information. Updated document with IRB terminology. DCR State Transition Diagram : a) Added an arrow from "Ready For Test" --> Ready For Closure b) Description box of "Test Completed" state: Kept only Description box which stated "Tester: Documents test results and indicates test completion" Removed the Description box which stated "Tester: Runs tests to verify" Adjusted the Description box of " Ready for Closure" state Simplified Figures 4.0-1 and 4.0-2 and updated with information from DCR meetings.	Section 6.0, All.
0.6	11/16/04	Formatting changes.	All
1.0	04/25/05	Incorporated changes in response to the following DCRs: - DCR92 “1- Add the names of the CMO, C&DH Lead, ACS Lead, Test Lead and Lab Manager on the Signature page for concurrence. 2- Provide more details on the Plan's scope, such as the phases to which the Plan applies, products covered (i.e., FSW but not Science instruments). - List major configurable items such as the ACS, C&DH as well as testbeds' software and hardware. - For critical items not managed by the FSW PDL, such as the GDS configuration, indicate how CM issues are handled between the 2 groups. 3- Define which items are under the control of the Project CM vs. the FSW CM. 4- In section 1.6 (reference listing), eliminate the documents that have no direct relationship to the CM plan. 5- Section 2.0-IRB definition Indicate members' role (voting members, non-voting members, Chair), and (non-FSW) experts' participation. 6- Merge sections 2.2 and 2.3-Combine CMO and Software Librarian roles. 7- Section 5.1.2- All FSW related products are equally important in the overall performance of the FSW; they should all be subject to the same degree of CM control, i.e., same category (instead of categories 1,2 and 3, indicate whether item is under FSW or Project CM).” - DCR104 “1- Add relevant DCR in Document Change Record section 2- Add "Action Items" section(describe how that is handled)	All

Version	Date	Description	Affected Pages
		3- Add "CM Records" section” - DCR105 1- State that IRB approval of any requirements change indicates team commitment to the change 2- Add short section on Data Management 3- Indicate how issues are collected, analyzed and resolved through Action Items tracking. 4- In CM Audit section, indicate what actions are performed automatically by CM tools and what has to be done additionally by people. Also mention in delivery letter.	

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1.0 INTRODUCTION

This section describes the purpose, organization, scope, and applicability of this Configuration Management (CM) Plan and describes the relationship between this plan and other documents.

1.1 DOCUMENT PURPOSE

This document is the Configuration Management Plan for the [Mission Acronym] Flight Software (FSW) system.

Any content deviations from this template must be approved and documented on the waiver page located in Appendix B of this document.

The purpose of this CM Plan is to establish, implement and maintain formal policies to identify the configuration of the [Mission Acronym] Flight Software (FSW) at discrete points in time, and to control all changes to that configuration in order to maintain the integrity and traceability of the software system and related documentation throughout the software life cycle.

[Use the paragraph above as is or augment with mission-specific information about the purpose of this plan]

1.2 DOCUMENT ORGANIZATION

Section 1 (Introduction) presents an overview of this Configuration Management Plan.

Section 2 (Configuration Management Organization) describes the Configuration Management Organization and lists its members and components and their responsibilities. Configuration Management interfaces are also described.

Section 3 (Configuration Management Process) defines the objectives and the processes of Configuration Management.

Section 4 (Project Phases and Milestones and Configuration Identification)) presents the Flight Software development life cycle for the [Mission Acronym] FSW, lists the formal baselines tied to life cycle products, describes the baseline categories and specifies numbering conventions used for [Mission Acronym] documentation..

Section 5 (Configuration Control) describes the responsibilities and processes of the Internal Review Board (IRB) and defines the process for documenting, tracking, and resolving FSW related Discrepancy Reports or Change Requests.

Section 6 (Configuration Status Accounting) discusses the configuration status accounting activities and the records/reports required to support management of the configured items.

Section 7 (Configuration Audits) outlines the validation activities to ensure that the software conforms to released documentation and any approved changes or discrepancies reported by subsequent DCRs.

Section 8 (Configuration Management Resources and Tools) lists the CM tools used, discusses the FSW Library backup and recovery, and outlines the training plan for the FSW Team members to effectively use those CM tools.

Appendix A (Acronyms and Abbreviations) defines the acronyms and abbreviations used in this document.

Appendix B (Waiver page) documents content deviations from this template

1.3 DOCUMENT SCOPE

This Configuration Management Plan presents the implementation and management approach of the CM system for the [Mission Acronym] FSW. It establishes the formal plans and policies for managing the configuration of the [Mission Acronym] FSW through phases C and D, and does not encompass phase E (on-orbit sustaining engineering). The scope is strictly limited to the [Mission Acronym] Spacecraft or [Instrument Name] and its associated products (e.g., support software). This plan defines the configuration identification, configuration control, status accounting and auditing of the following FSW-related products:

- Flight software,
- Software development applications software,
- Compilers, operating systems, and other support software,
- Ground system databases,
- Telemetry and command databases,
- Software-based simulators, test data, test tools and test procedures, simulator configuration procedures and script files,
- Software documentation.
- Testbeds
- FSW development and test strings

Under this plan, Configuration Software Configurable Items (CSCIs) will be defined to enable the control, tracking and restoration of all FSW load images of any given release at any time. The list of CSCIs shall include all the FSW processors for the [Mission Acronym] project such as:

- ACE (A/B)
- GCE (A/B)
- S-Band Comm (A/B)
- PSE (A/B)
- Main processor (ACS and C&DH)
- …

For FSW related products not developed by this [Mission Acronym] FSW development team, cross-organizational CM issues related to the product delivery and subsequent configuration management and change control must also be addressed.

In addition, some of the products covered under this plan are further subject to Project oversight for change control purposes. These products require the [Mission Acronym] Project Office CCB's approval before major changes are applied to their configuration (refer to the change control flow illustrated in figures 3.0-1 and 3.0-2 for a glimpse into Project involvement in the configuration control process, and to Table 5.1.2-0 for a listing of Project controlled products).

1.4 DOCUMENT DEVELOPMENT, REVIEW, APPROVAL, AND UPDATE

This Configuration Management Plan was developed by the FSW Team Lead and reviewed and approved by members of the FSW Branch and the [Mission Acronym] Project, as listed on the signature page.

The baseline version of this plan is produced between the FSW Preliminary Design Review and the FSW Critical Design Review. After initial approval, the document is treated as a Controlled Document. Changes are listed in the Plan Update History.

[Use the paragraph above, or replace with mission-specific information about the development/update cycle for this plan]

1.5 RELATED DOCUMENTS

The parent documents of this CM Plan are the [Mission Acronym] Project Office Configuration Management Procedures, and the [Mission Acronym] Flight Software Product Development Plan.

This document is one of a pair of related documents forming a complete description of [Mission Acronym] FSW CM:

- This document describes the application of CM best practices to the [Mission Acronym] FSW development effort at a level intended to be independent of the specific software tools used.
- The [Mission Acronym] Flight Software Configuration Management Procedures document extends the level of detail down to specific software tools and procedures required to accomplish the following:
    - Modify software
    - Compile and link modules
    - Generate a new software element build
    - Maintain related documentation
    - Release software to test personnel
    - Controlled release of software to other software developers.

1.6 REFERENCES

This document references explicit versions of several Goddard Procedures and Guidelines (GPGs), and FSW Branch standards documents. The policy with respect to how changes in these documents affect this document is as follows:

The versions referenced are current at the time of writing. If a GPG (or standards document) changes at a point in the development life cycle after which the referenced process is no longer being used, the reference in this document shall not be updated. For example, if we reference Revision A of the Procurement GPG, and Revision B is released after we have finished all procurements on this project, it would be incorrect to update the reference – the procedure actually used for procurement was Revision A.

If there is a change in a GPG (or standards document) relating to a process that has not yet been completed, the change shall be evaluated for impact on the content of this document and the related development process. In this case, the reference shall be updated to reflect the new version, along with required changes (if any) to the document. It shall not be necessary to update the signature page in this case.

The following documents are references for this Configuration Management Plan:

- [Mission Acronym] Project Office Configuration Management Plan
- [Mission Acronym] Project Office Configuration Management Procedures
- [Each applicable ICD]
- Design Planning and Interface Management [GPG 8700.1]
- Process Control [GPG 8072.1]
- Product Processing, Inspection, and Test [GPG 5330.1]
- Configuration Management [GPG 1410.2B]
- Records Control [GPG 1440.7D]

[Include the paragraph above and add to the list of reference documents as needed.]

The following web addresses are references for this document:

System	URL
FSW Branch Internal Website	<http://fsw.gsfc.nasa.gov/Internal/>
FSB Baselined Standards, Guidelines and Templates	<http://fsw.gsfc.nasa.gov/internal/StandardsBaselined.cfm>
[Mission Acronym] FSW web page	<tbs>

2.0 CONFIGURATION MANAGEMENT ORGANIZATION

2.1 THE INTERNAL REVIEW BOARD

The primary [Mission Acronym] FSW configuration management organization is the Internal Review Board (IRB). The IRB operates internally to a FSW development team and has controlling authority over the configuration of that team's FSW related products. As such, the IRB reviews proposed changes to all FSW related elements designated for control, estimates the cost and schedule impact of the changes, dispositions and tracks the status of DCRs written against these elements and authorizes DCR closures.

DCRs that have cost/schedule/risk implications or that are written against non-FSW products are respectively referred to the Project CCB or to the appropriate external CCB before being internally dispositioned by the IRB. DCRs with "Requirements" impact are elevated to the CCB level. The IRB's approval of "Requirements" changes indicates that the commitment of all relevant stakeholders (including the development team) has been obtained.

The IRB voting members shall include each FSW Development Team Lead (e.g., ACS, C&DH), the FSW Test Team Lead, and the FSW PDL performing the role of Chair. Non-voting members shall include the CMO and the FSW Lab Manager. Other software team members may be required to attend IRB meetings at the discretion of the Chair and other board members. Depending upon the agenda and subject to the discretion of the Chair, additional representation may be required (i.e., spacecraft or systems engineering, simulations, ground systems or other relevant personnel) to ensure the necessary expertise to adequately address the issues under consideration.

The following subsections describe the major duties and responsibilities of the formal configuration management positions defined with the IRB.

[Use the following descriptions in subsections 2.2 – 2.4 or modify as appropriate. For example, if two roles are to be performed by one person, state so.]

2.2 IRB CHAIR (FSW PDL)

The FSW PDL is the Chair of the IRB and the final decision point of IRB actions. However, the FSW PDL may not make DCR dispositions without first convening the FSW IRB and having the appropriate representatives in attendance for the DCR(s) to be discussed. There shall be no instance that the DCR(s) shall be approved without the relevant FSW Development Team Lead and the FSW Test Team Lead (or representatives) in attendance.

The FSW Product Development Lead (PDL) has three major responsibilities:

- Establish the FSW IRB and designate the CMO and/or Librarian,
- Control, evaluate, and approve all configuration definitions affecting FSW-related items,
- Sign and approve all FSW documentation, FSW baseline versions, and FSW Discrepancy or Change Requests (DCRs). The Software Librarian may advise and assist in the execution of this responsibility.

2.3 CONFIGURATION MANAGEMENT OFFICER/ SOFTWARE LIBRARIAN

The functions of a Configuration Management Officer (CMO) and of a Software Librarian are often indistinguishable from one another and are often performed by the same individual. The CMO/Software Librarian reports directly to the FSW PDL and is delegated the necessary authority to implement this plan. The following three major responsibilities are associated with this dual role:

- Design, implement and maintain the CM system,
- Coordinate, support, and perform CM activities and report on those activities to the FSW PDL,
- Use the CM system, in conjunction with documented procedures, to ensure the integrity of all items placed under configuration control, and maintain master copies of controlled products for archival and controlled release.

In addition to the responsibilities delineated above, this individual shall be responsible for organizing the software files and documentation received from the software developers and for building a centralized software library. The CMO/Software Librarian is the only individual authorized to establish, archive and provide files containing IRB-controlled software products. In addition, he/she shall establish a program support library for retention and controlled retrieval of software support documentation and change control records.

2.4 FSW INTERNAL REVIEW BOARD (IRB) INTERFACES

The Flight Software IRB accepts Discrepancy Change Requests (DCRs) from any member of the Project who may have encountered a problem with the FSW or would like to request implementation of an enhancement to the FSW.

DCRs that are determined by the FSW IRB to adversely affect Performance, Cost, Schedule, Scope, and/or Risk shall be forwarded as Configuration Change Requests (CCRs) to the Project Office CCB for dispositioning.

After successful Acceptance Test of the FSW, all change requests and problem reports against the Flight Software will be forwarded as Configuration Change Requests to the Project Office CCB for dispositioning.

The FSW IRB shall also consult with the Project Systems Engineering Office, when proposed changes result in an impact to spacecraft resources (i.e., cost, schedule, risk) and/or interfaces to other subsystems.

The FSW IRB Chairman also functions as the Nonconformance Lead (NCL) when Nonconformance Reports (NCRs) against the FSW have been entered into the GSFC NCR/CAS system.

3.0 CONFIGURATION MANAGEMENT PROCESS

Software configuration management is the discipline of identifying the configuration of software products at discrete points in time and systematically controlling changes to the identified configuration for the purpose of maintaining software product integrity and traceability throughout the software life cycle.

To accomplish the objective given in the definition above, there are four identified CM functions:

- **Configuration Identification**: identification of the components that make up the software system and definition of its functional characteristics; detailed in Section 4.0.

- **Configuration Control**: control of changes to those components; detailed in Section 5.0.

- **Configuration Status Accounting**: reporting of status of the processing of change requests and their implementation status; detailed in Section 6.0.

- **Configuration Authentication**: audits to authenticate that the controlled items meet their requirements and are ready for delivery; detailed in Section 7.0.

This CM plan establishes the processes the FSW team shall use to manage the configuration items and changes to them. Figure 3.0-1 provides a high level work flow of the FSW Requirements Change process, and Figure 3.0-2 provides a high level work flow of the FSW Discrepancy Report process. In either case, a DCR is entered to request a change to the FSW requirement(s) or to report a problem identified with the FSW.

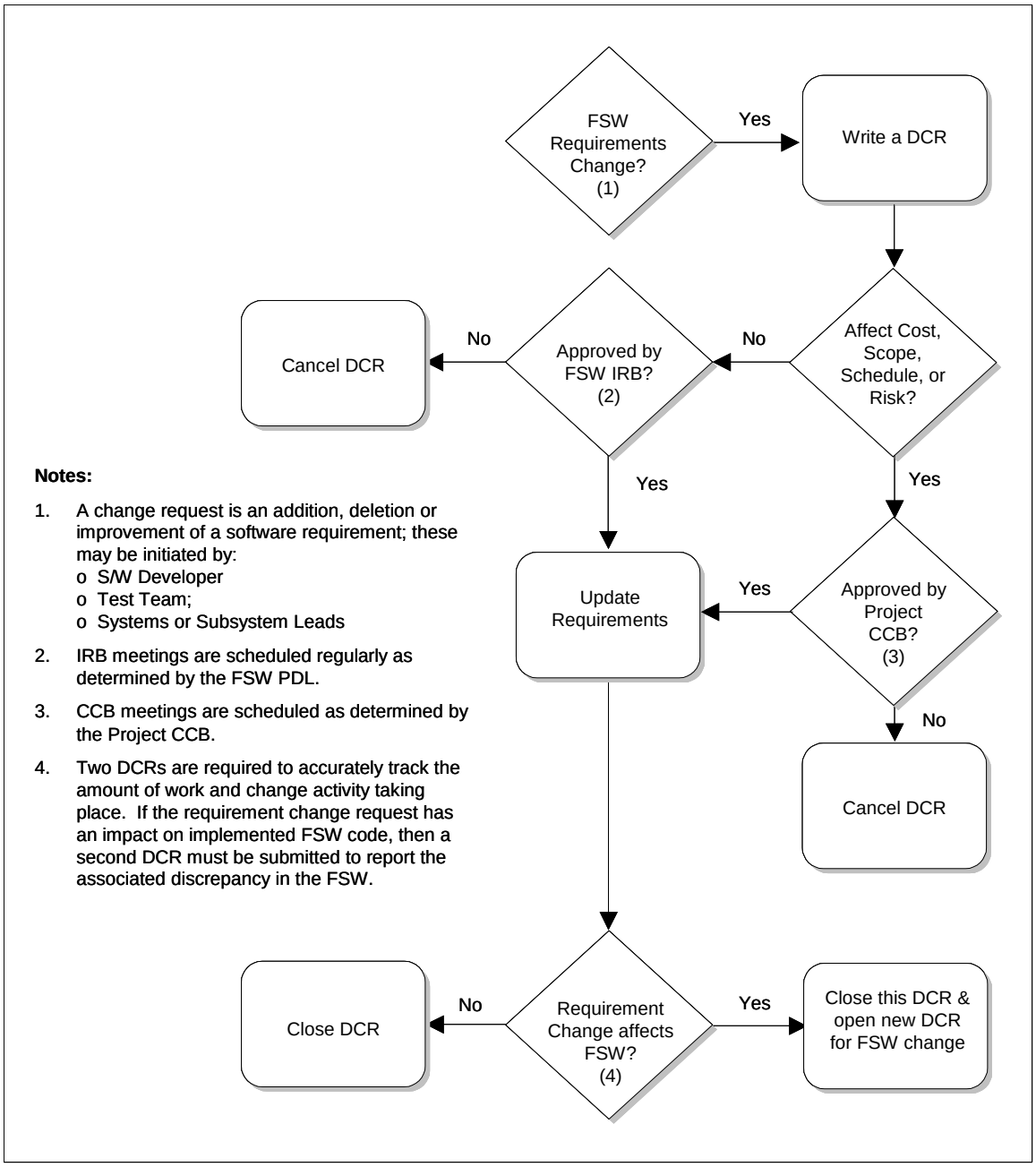
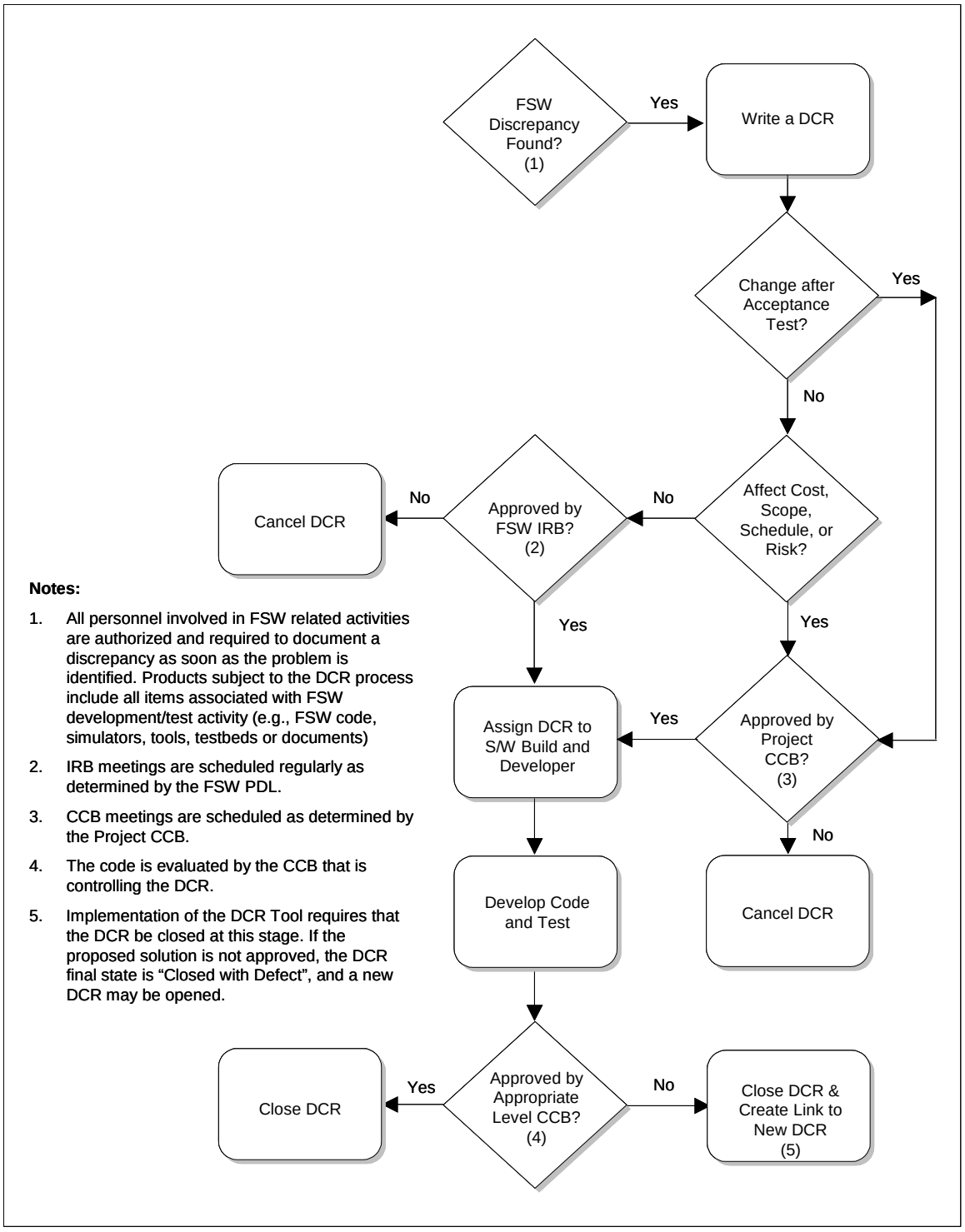


Figure 3.0-1 FSW Requirements Change Workflow



Notes:

1. All personnel involved in FSW related activities are authorized and required to document a discrepancy as soon as the problem is identified. Products subject to the DCR process include all items associated with FSW development/test activity (e.g., FSW code, simulators, tools, testbeds or documents)
2. IRB meetings are scheduled regularly as determined by the FSW PDL.
3. CCB meetings are scheduled as determined by the Project CCB.
4. The code is evaluated by the CCB that is controlling the DCR.
5. Implementation of the DCR Tool requires that the DCR be closed at this stage. If the proposed solution is not approved, the DCR final state is “Closed with Defect”, and a new DCR may be opened.

Figure 3.0-2 FSW DCR Workflow

4.0 CONFIGURATION IDENTIFICATION

Configuration identification is the ongoing process of identifying and documenting a software product at significant stages in its development.

The documents that are configured by the [Mission Acronym] Project shall have the numbering convention as prescribed in the [Mission Acronym] Project Office Configuration Management Plan. Documents that are configured by [Mission Acronym] FSW CM shall have the following numbering convention: [XXX-FSW-nnnn].

The numbering conventions identify which organization exercises configuration control authority over a specific document.

4.1 PROJECT PHASES AND MILESTONES AND CONFIGURATION BASELINES

This section describes the evolution of the [Mission Acronym] FSW with respect to FSW CM and describes the establishment of both developmental and formal baselines.

Figure 4.0-1 illustrates the typical Flight Software life cycle for in-house missions. The number of builds varies by project, but the relative phasing of builds, FSW reviews, and major spacecraft events generally map to figure 4.0-1.

[List any deviations from the typical Flight Software life cycle, or leave this sentence out if there are none.]

The relationships between CM milestones and the FSW reviews shown on this diagram are discussed in Section 4.1.1 (Configuration Baselines).

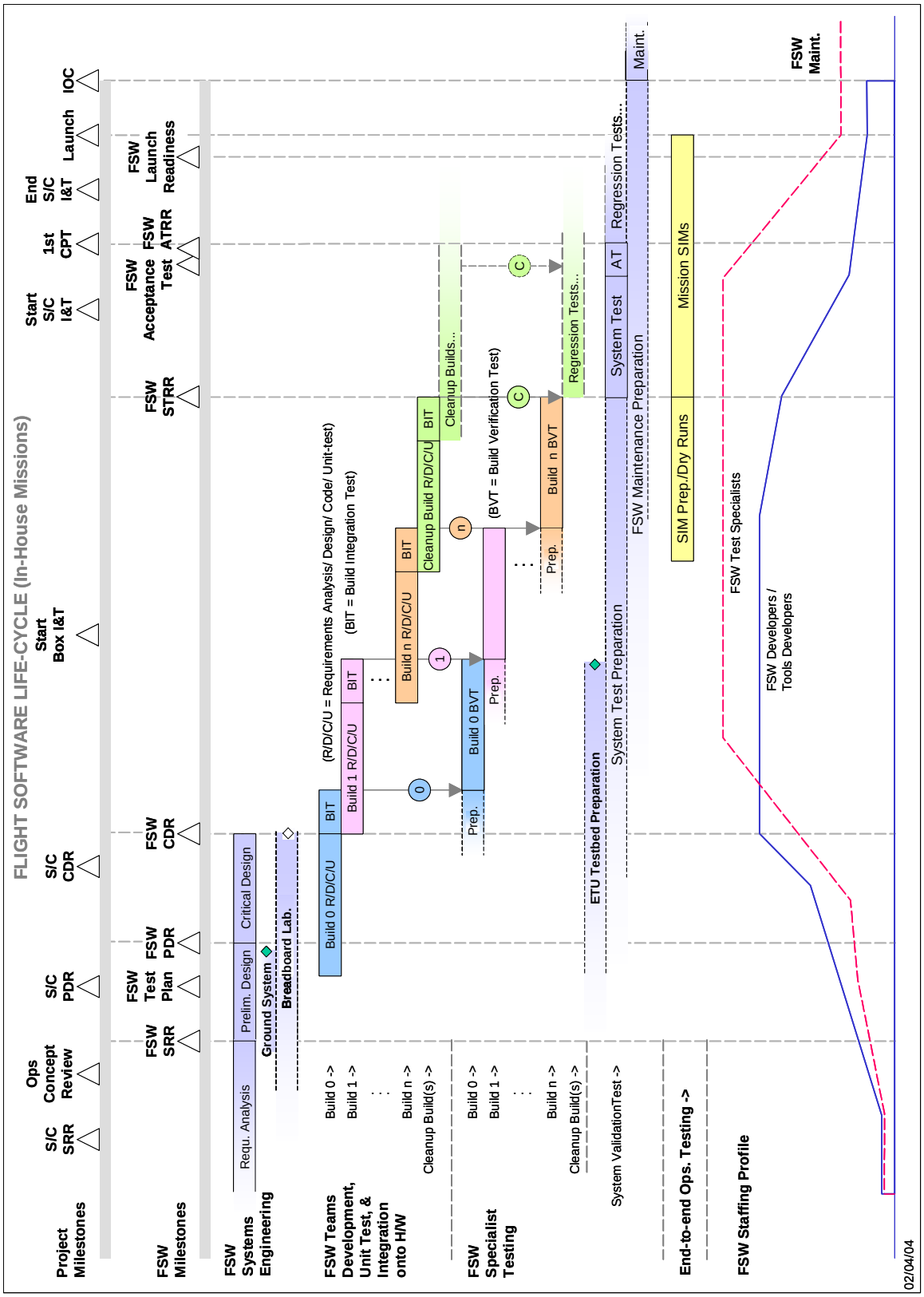


Figure 4.0-1 FSW Life-cycle

4.1.1 Configuration Baselines

The [Mission Acronym] Flight Software Product Plan specifies completion criteria for each development lifecycle phase. This section defines the formal baselines that are associated with FSW lifecycle products.

[Add to or delete from the following lists, as appropriate, for the specific mission to which this plan applies.]

Planning Baseline -- The Planning Baseline consists of:

- [Mission Acronym] Flight Software Product Plan
- [Mission Acronym] Flight Software Configuration Management
- [Mission Acronym] Flight Software Test Plan
- [Mission Acronym] Flight Software Configuration Management Procedures document

The Planning Baseline is established at completion of the FSW Requirements Review and updated as required.

Requirements Baseline -- the Requirements Baseline consists of:

- [Mission Acronym] Spacecraft Flight Software Requirements Documents (including traceability with parent documents)

The Requirements Baseline is established at completion of the FSW Preliminary Design Review.

Functional Baseline -- the Functional Baseline is the result of the FSW preliminary design phase and consists of:

- [Mission Acronym] Flight Software Requirements Review / Preliminary Design Review (SRR/PDR) Presentation Package
- [Mission Acronym] Flight Software Developer's Guide
- RFA and Disposition List

This baseline is established after completion of the FSW PDR.

Design Baseline -- the Design Baseline is the result of the FSW detailed design phase and consists of:

- [Mission Acronym] FSW CDR Presentation Package
- Flight, Command, Telemetry and Events List and/or Spreadsheet
- Required Interface Control Documents (ICDs)
- RFA and Disposition List

This baseline is established after completion of the FSW CDR.

Build Product Baselines – During the software implementation phase, each incremental software build is defined as a Build Product Baseline. Two build product baselines are defined: the development baseline and the test baseline.

Build Development Baseline:

The Build Development Baseline is the formal product of a successful Build Integration Test. The build has been fully run in a closed loop environment with the simulators. This baseline is delivered by the Development team and shall consist of, at a minimum:

- [Mission Acronym] Flight Software Version Description Documents
- Flight Software source code files
- Flight Software make files
- Flight Software development and test build files
- [Mission Acronym] Flight Software Telemetry Definition Document
- [Mission Acronym] Flight Software Command Definition Document
- Table definitions
- Event messages
- Flight Software Unit Test software
- Flight Software Unit Test data
- Flight Software Unit Test reports
- [Mission Acronym] Flight Software User's Guide
- Flight Software Images

Build Test Baseline:

The Build Test Baseline is delivered after the Build Verification process has been completed. This baseline shall be delivered by the build test team and shall consist of, at a minimum:

- Flight Software Build Test Scenarios
- Flight Software Build Test Procedures
- Flight Software Built Test Scripts
- [Mission Acronym] Flight Software Build Test Description Document
- Flight Software Build Test input, data, and results

- Flight Software Build Test reports
- Flight Software Build Test verification matrix

Essentially, all software, documentation and test products that are used to verify a build shall be controlled. It should always be possible to 'back-up' to a previous build and completely regenerate/revalidate the build tests. The Build Product Baselines are established after the successful integration test of all program subsystems making up each build.

System Baselines – The System Baseline is defined as the final build product baseline but the focus is not on a specific processor, but on the FSW system as a whole. Two system baselines are defined: the development baseline and the test baseline.

System Development Baseline:

The System Development Baseline is the formal product of the final integrated FSW system. This baseline is delivered by the development team and shall consist of, at a minimum:

- Flight Software Version Description Documents
- Flight Software source code files
- Flight Software make files
- Flight Software development and test build files
- [Mission Acronym] Flight Software Telemetry Definition Document
- [Mission Acronym] Flight Software Command Definition Document
- Table definitions
- Event messages
- Flight Software User's Guide
- Flight Software Images

System Test Baseline:

The System Test Baseline is delivered after the system validation process has been completed. This baseline shall be delivered by the system test team and shall consist of, at a minimum:

- System Validation Flight Software Test Scenarios
- System Validation Flight Software Test Procedures
- System Validation Flight Software Test Scripts
- [Mission Acronym] System Validation Flight Software Test Description Document
- System Validation Flight Software test input data

- System Validation Flight Software test reports
- System Validation Flight Software test verification matrix

The System Baselines are established after the successful integrated test of all program subsystems making up the build. It is essential that all software, documentation and test products that are used to validate a build shall be controlled if it is ever necessary to 'back-up' to a previous build.

Acceptance Baseline - The Acceptance Baseline consists of the fully integrated software system (the final build) that has gone through complete software system Acceptance Test. This baseline is the software that shall support spacecraft Integration & Test (I&T). It contains the results of the acceptance test phase and consists of the following software and related "as-built" documentation:

- [Mission Acronym] Flight Software System Test Plan
- Flight Software System Development Baseline artifacts
- Flight Software System Test Baseline artifacts
- Flight Software System Test procedures/scripts
- Flight Software System Test Description Document
- [Mission Acronym] Flight Software Acceptance Test Review Package

This baseline is established at the completion of the FSW Acceptance Test Results Review.

Maintenance and Operations Baseline - The software system that shall be used for spacecraft operations. This baseline is established at the completion of spacecraft I&T and consists of the final I&T baseline products. This baseline shall be handed over to the FSW maintenance team and shall include:

- Acceptance Baseline artifacts
- Acceptance Test artifacts
- Flight Software Validation and Test Facility

4.1.2 Controlled [Mission Acronym] FSW Products and Associated Configuration Baselines

All products directly related to the design, development, testing and delivery of the [Mission Acronym] Flight Software shall be subject to the same degree of configuration control to preserve the integrity of the Flight Software throughout all development phases. Whether they are internally developed, or commercial off the shelf (COTS) products obtained with or without the source code, all these products must be governed by strict configuration management rules such as a Discrepancy Report and Change Request (DCR) system to provide the control necessary to document, justify, verify, and track changes to closure.

The following table (4.1.2-0) provides a summary (not all inclusive) of the products subject to that kind of control, the controlling organization ('P': Project controlled, otherwise IRB controlled) and associated configuration baselines.

Note- All baselines of Project controlled documents are to be submitted to and kept by the Project Office from which official versions of these documents must be obtained.

Table 4.1.2-0 Configuration Baseline Summary

Software Element	Org.	Configuration Baseline							
		Plan.	**Req.**	**Funct.**	**Des.**	**Build**	**Syst.**	**Acc.**	**Maint & Ops**
ACS Flight Software Requirements Document	P		●						
Simulator (1) models					●	●	●	●	●
Simulator (1) Software					●	●	●	●	●
Simulator (1) Design					●	●	●	●	●
Telemetry definitions, command definitions (Project controlled from the beginning of the I&T phase)	P				●	●	●	●	●
Software source code files, program listings, command files						●	●		
FSW Build Generation Files (Make, Link, etc.)							●	●	●
FSW Real-time O/S							●	●	●
Commands, Telemetry, Events, Tables							●	●	●
FSW Development Tools (e.g., tools to build stored command loads, etc.)							●	●	●
FSW Product Plan	P	●	●						
Flight Software Configuration Management Plan	P	●	●						
Flight Software Test Plan	P	●	●						
Flight Software Configuration Management Procedures Document		●	●						
Flight Software Data System Requirements Specification			●						
Flight Software Functional Design Documents				●					
Flight Software Detailed Design Documents					●				
Flight Software Developer's Guide					●				

Software Element	Org.	Configuration Baseline							
		Plan.	Req.	Funct.	Des.	Build	Syst.	Acc.	Maint & Ops
Annotated Flight Software Detailed Design Documents						●	●		
Test Scenarios					●	●	●	●	●
GDS Documentation (specifications, user documentation, requirements)					●	●	●	●	●
Simulator (GDS) Version						●	●	●	●
Test Results						●	●	●	●
Software Version Description Documents						●	●		
Flight Software Unit Test Reports						●	●		
Flight Software Build Test Procedures						●	●		
Flight Software Build Test Reports						●	●		
Systems Test data files						●	●	●	●
Build test verification matrices						●	●	●	
Build test procedures						●	●	●	●
Build test reports						●	●	●	
Unit Test Software							●	●	●
Test Procedures							●	●	●
Test Data Supplied by External Organizations							●	●	●
Software Acceptance Test procedures								●	
Flight Software Acceptance Test Report								●	●
Final update of all software documents								●	●
Flight Software Compilers & Linker (2, 3)						●	●	●	●
Development Facility COTS Software						●	●	●	●
Flight Software test tools						●	●	●	●
Test data files						●	●		

(1) "Simulator" refers to any such instrument such as GN&C, science instrument, s/c, power, gimbal control, etc.

(2) Compilers and linkers shall be frozen at the conclusion of Build 1 Verification test to provide adequate opportunity to mitigate risk of compiler/linker defects.

(3) Once a Build has been verified, any change in the compiler shall require the Build to be retested at a level to be determined, on a case by case basis, by the FSW IRB in consultation with the Project Management Office, if necessary.

4.1.3 [Mission Acronym] FSW Products and Data Management

Products that do not directly affect the design, development or testing of the [Mission Acronym] Flight software do not require the stringent "check in", "check out" mechanism mandated for the items in Table 4.1.2-0. Work products not checked into CM will be placed in a known repository accessible to [Mission Acronym] personnel via system login or other means deemed applicable based on the type of repository. A copy of each applicable product will also be added to the team repository on the FSW internal website at: http://fsw.gsfc.nasa.gov/internal/[Mission Acronym]/.

4.2 ELEMENT IDENTIFICATION

The development team shall utilize identification and marking conventions for all documents, specifications and physical items related to software. This shall ensure the necessary traceability during the lifecycle of all computer program configuration items. The identification system for [Mission Acronym] shall observe the following convention.

Each release shall be uniquely identified with a 3-character code of the form:

X.Y where:

X is numeric and refers to the major build identifier, as in Build 1 or Build 2

Y is numeric and refers to the minor build identifier, as in Build 2.1

Major Build identifiers are used to distinguish builds that introduce significant features, absent from previous builds.

Minor Build identifiers are used to distinguish builds which contain modifications to functionality delivered in previous builds, but do not introduce significant features, absent from previous builds. For example, support for the data recorder is considered a feature, but providing an over-write capability to the recorder is considered a function.

5.0 CONFIGURATION CONTROL

Software configuration control is the systematic control of all software products throughout the software life cycle of the Project. It provides the mechanisms for tracking software modifications and approvals of modifications and, as a result, provides visibility into the status of the software work.

Controlled versions of every software product shall be uniquely identified, controlled, and maintained in the Software Library. This establishes a single centralized source for the current approved version of each software product and provides traceability of changes. For change purposes, controlled access shall be established for each software product to a single responsible individual.

Configuration control procedures shall define how to perform formal control and maintenance of documentation, source files, hardcopy listings, directory structures, command sequences, etc. Procedures to archive and restore directory files shall also be defined, as shall security privileges and protection of files under CM control from unauthorized access. Procedures shall also address the content of status accounting reports and the procedures to maintain the data for the reports. These procedures shall be defined in [Mission Acronym] Flight Software Configuration Management Procedures document.

A catalog of all software configuration items (for all software elements) is necessary; as is a status list for all items in the catalog and all Discrepancy or Change Requests (DCRs). Reports are to be produced to support configuration status accounting and configuration audits (see Sections 6.0 and 7.0).

5.1 CONFIGURATION CONTROL FUNCTIONS

The following configuration control functions shall be executed via the online forms interface provided by the CM/DCR system.

A single form shall be used for both discrepancies and software changes. The form itself encourages entering the necessary information to support both needs. The user interface for entering DCRs is described in the [Mission Acronym] FSW Configuration Management Procedures document.

A discrepancy implies that an error exists. It could be a software problem or improperly implemented or missing requirement, a user error or a hardware error. Discrepancies must be resolved. A change request is an addition, deletion or improvement of a software requirement and as such represents a desired change to software, not an error correction.

All personnel involved in FSW related activities are authorized and required to document a request for change in a controlled product or a discrepancy as soon as the problem is identified. Products subject to the DCR process include all items associated with a FSW development or test activity (e.g., FSW code, simulators, tools, testbeds or documents) as summarized in Table 4.1.2-0 – Configuration Baseline Summary. A Software DCR is required whenever a software configuration item is to be submitted to the Software Library. All products to be entered into the configuration control system shall require this authorization.

5.1.1 The DCR Process

The DCR process shall be implemented through the use of a tool configured to track the defective FSW related products and to capture the characteristics of every documented DCR. The list of products to be tracked in the DCR tool shall be defined by the FSW Product Development Lead (PDL) and comprise unique identifiers for each relevant FSW subsystem, each component of these subsystems, all deliverable items, including simulators, tools, ground systems, every major component of each FSW testbed, and documents.

Figure 5.1-1 provides a flow diagram of the DCR States and Responsible Transition Authorities:

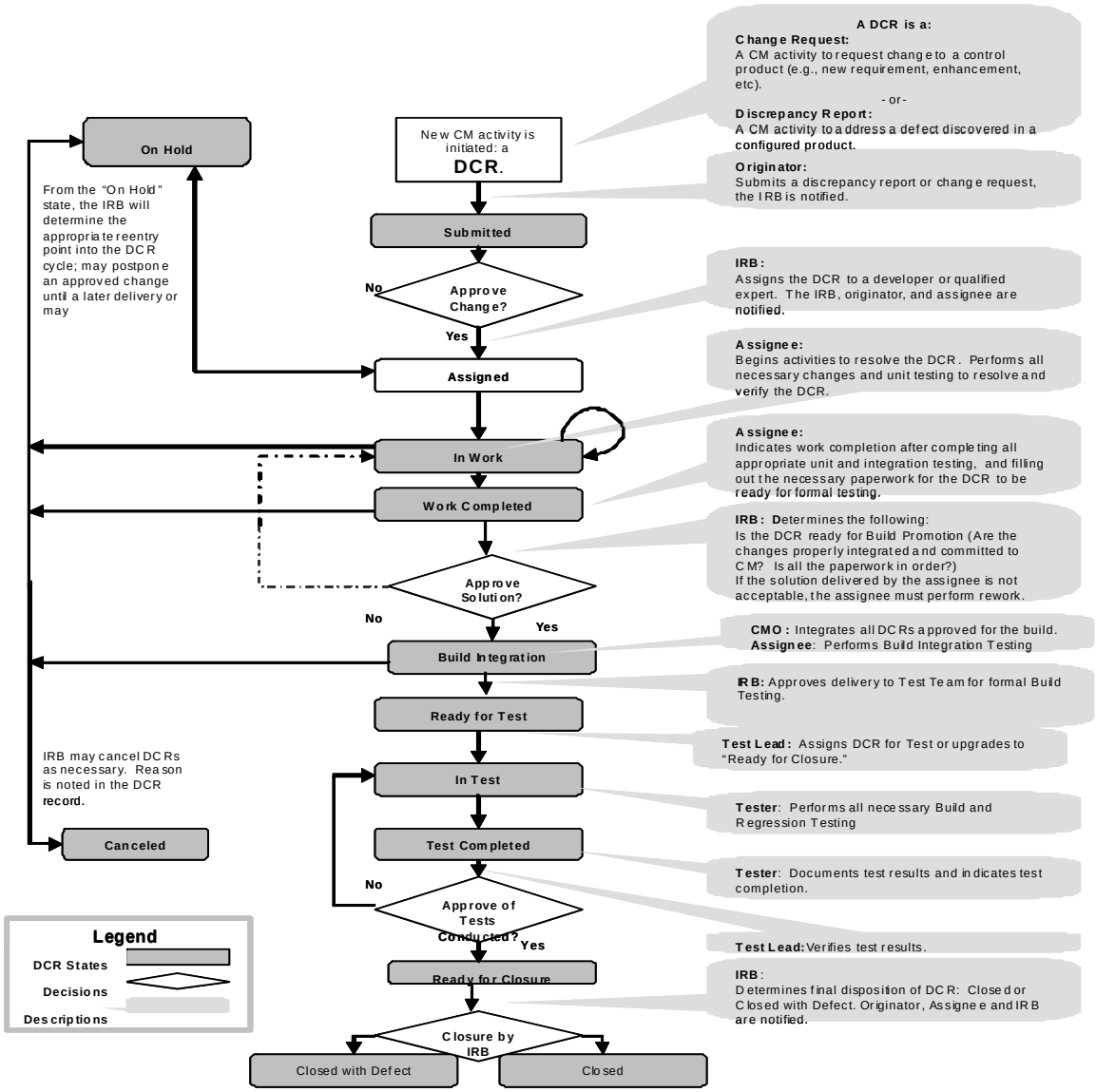


Figure 5.1-1 DCR States and Responsible Transition Authorities

5.1.2 The DCR States

For an overview of the DCR states, refer to the "DCR Requirements Document" located at: http://fsw.gsfc.nasa.gov/internal/DDB/DDB_SpecificDoc.cfm?DDBName=StandardsCCB&DocNumber=582-2005-002&DocVersion=1.1.

5.2 IRB PROCESS

This section documents IRB activities and associated processes.

5.2.1 IRB Meetings

The FSW IRB shall meet at the direction of the chairman. The CMO shall generate an agenda containing DCR abstracts. Acting as the IRB secretary, the CMO shall maintain a record of IRB proceedings, decisions, and recommendations. At the meeting, DCR packages shall be distributed and discussed. The chairman shall encourage clarifications, counsel and advice. The IRB chairman shall ensure that all interested parties have the opportunity to present their views relative to the requested changes and to adequately represent their interests. The criteria for disposition decisions include:

- Operational Impact
- Reducibility
- Feasibility
- Performance Impact
- Impact on Support Equipment
- Documentation and Manuals
- Testability
- Resource Availability
- Contractual Requirements
- Schedule
- Cost

Based on these criteria, the IRB members shall make recommendations to the chairman for review and evaluation. A vote shall be taken and unanimous concurrence shall be sought. The IRB chairman shall make a decision for approval, deference, or rejection. Completed DCRs shall be reviewed and signed off or reassigned, as appropriate. This process shall continue until all items on the agenda have been resolved. Changes affecting cost, schedule or scope shall be elevated to the Project CCB for disposition. Changes affecting the interfaces of other subsystems shall be referred to Project systems engineering for risk assessment.

All changes shall be classified by the IRB as to severity according to the following criteria:

- **1 – Critical:** A problem that prevents operational use of the FSW subsystem.
- **2 - Urgent:** A problem that has direct impact upon the FSW subsystem milestone schedules. An urgent problem can be temporarily handled procedurally (i.e. there is a “work around”)
- **3 - Routine:** A problem that does not prohibit successful completion of a test.

Minutes of the meeting shall be recorded, and published on the [Mission Acronym] FSW web site.

5.2.2 Action Items Tracking

In addition to meeting minutes, action items are typically recorded by a designated member of the IRB. Action items may be immediately assigned or may be deferred pending further analysis. FSW missions have an "Action Items" tracking system, where action items are recorded and monitored through closure. Assigned action items usually have a due date and are monitored by the IRB if they apply to the configuration of the FSW related products under the IRB's jurisdiction; otherwise they are monitored through the appropriate development team or status meetings. Through the "Action Items" tracking system, the assignee can record the proposed solution (as applicable), and progress on each individual item can be tracked up to the point of closure. Action items closures require the sign-off of the PDL or a clearly designated delegate, and are achieved when the solution of the action item has been reviewed by the body from which it originated and shown to satisfactorily resolve the issue(s) or achieve the intended goal.

5.2.3 CM Records

Meeting agendas, minutes and action items lists are typical records resulting from IRB meetings

5.3 SOFTWARE LIBRARY

The Software Library shall be established for the controlled storage, release, and distribution of all software configuration items - master copies of software media (e.g., files, compact discs) and the master copies of software documentation (e.g., specifications, code listings, design documents, manuals, etc.). The library shall be the single source of reference for the current approved version of each software product and shall provide traceability of all changes. The software library shall be managed by the CMO.

The primary functions of the Software Library are to:

- Provide off-line storage of the master copies of software media, software documentation DCRs, etc.
- Provide controlled release, to authorized persons only, for updates of software media and software documentation
- Provide controlled distribution of updated software documentation
- Maintain records of software media and documentation that are withdrawn from the repository and resubmitted. Basic data to be maintained are:
    - Item description and identification, version or revision
    - Authorizing document, person, and organization withdrawing
    - Date of release, person, and organization re-entering
    - Date of re-entry, purpose, and new identification, version or revision, if applicable
- Allow only authorized access to the repository to prevent unauthorized changes and unauthorized distribution
- Maintain records on each controlled software item that provides traceability between each module, function, and routine, to the applicable design and code listings
- Provide backup copies of all stored items:
    - Weekly full backups

- Daily incremental backups
- Backup media stored in a separate building

On-line directories, created, owned, and controlled by CM, shall be established with privileges and protection to prevent unauthorized access and use of files under CM control. The CM system shall provide controls and mechanisms to deal with concurrent updates of an item by multiple developers.

Each file shall be assigned a unique version number when resubmitted to CM after updates. This provides traceability, the capability to regenerate a specified previous version or baseline, and a mechanism to reconcile any discrepancies between the status data base contents and the actual software.

6.0 CONFIGURATION STATUS ACCOUNTING

Configuration status accounting activities provide for the input and maintenance of CI status information into the CM status database. Status accounting activities shall report the status of approved configuration items and the status of approved changes.

6.1 STATUS ACCOUNTING REPORTS

The DCR coordinator or some designated personnel shall maintain the official DCR status records. In addition to reporting the status of each open DCR on a periodic basis, the DCR coordinator shall maintain statistics and graphs that show the total number of DCRs recorded and the number of unresolved DCRs. These statistics can be used to detect unexpected trends and to forecast the number of DCRs to expect for later builds. The DCR tool shall support a variety of DCR tracking queries to support different aspects of statistical reporting.

The following reports shall be generated and maintained:

- Document Release Records
- DCR Status Report and Action Item List
- Configuration Articles List
- Miscellaneous Status Reports

The following Subsections define the purpose and usage of these reports.

6.1.1 Document Release Records

A document release record is prepared for each controlled document. The record identifies each document by identifier and title, and contains the initial release date of the document. The record is maintained to reflect the approval of any change and/or the release of subsequent revisions.

6.1.2 DCR Status and Action Item Report

The DCR status report identifies each DCR that has been submitted to the CMO for processing. It is used to track the status and disposition of all changes. The report lists the DCRs in numerical sequence and includes the names of the CI element/sub-elements affected, the date opened, date closed, and disposition. It also identifies all actions necessary for processing a DCR through the required approval cycles, and identifies and tracks actions necessary for implementing the change. An up-to-date copy shall be available for each IRB meeting and shall be distributed with updates in each issue of the IRB minutes.

The following trend indicators shall be periodically reported, the frequency determined by the CMO and the Librarian:

- Number of unresolved DCRs at the start of the reporting period
- Number of DCRs opened during the reporting period
- Number of DCRs closed during the reporting period
- Number of unresolved DCRs at the end of the reporting period

- Total number of DCRs
- Total number of closed DCRs
- Total number of opened DCRs
- Total number of opened DCRs by severity
- Total number of opened DCRs by state
- Total number of opened DCRs by type

The following information shall be periodically reported for each DCR, the frequency determined by the CMO and the Librarian:

- The DCR identifier, severity, and a summary of the discrepancy/change description
- Priority assigned to the solution effort.
- Status, including group currently assigned responsibility.
- Planned build (or iteration, or release) in which the solution will be implemented.

6.1.3 Configured Articles List

The CMO, with the Librarian, shall prepare and maintain a Configured Articles List that describes the exact configuration identification of the software and documentation.

6.1.4 Miscellaneous Status Reports

Examples of other status reports are:

- Source file summary listings - a directory and abstract of all routines, source code and data files of a baseline.
- Version Description Report containing:
- An inventory of materials released
- Changes installed
- Installation instructions
- Known problems.
- Listing of open DCRs

7.0 CONFIGURATION AUDITS

Configuration audits validate that the software conforms to released documentation and approved changes thereto (i.e., the as-built configuration matches the as-designed configuration). Audits are scheduled at the discretion of the PDL.

The audit team shall consist of the PDL, the CMO and selected members of the technical team. Configuration audits are generally conducted with build deliveries and will include the following checks:

1. Ensure that only approved items (from the Build Plan) and approved changes (recorded in the MKS DCR tool) are applied to existing baselines. All configuration items being delivered will be checked to ensure that the associated files, documents and listings are present and labeled with the required markings and identification (the markings will consist of the correct build tags from the [Mission Acronym] CM tool). Moreover, change record packages created in the MKS DCR tool to identify all files modified in association with a DCR, are checked to obtain an accurate listing of files to be delivered.

2. Ensure that all DCRs have been incorporated and verified. The [Mission Acronym] DCR tool can be used to extract all DCRs associated with a build and DCR status. The PDL can verify that all the associated DCRs are listed in the VDD, and the Requirements-to-Test matrix (RTTM) can be used to quickly verify DCR pass/fail status.

3. For each applicable delivery, test scenarios, associated procedures and reports, will be reviewed to determine test coverage, verify that all approved changes are reflected in the software tests and that the test results are completely and accurately documented. If deficiencies are noted, plans for additional testing will be made. The RTTM will also be checked to ensure that the requirements related to the DCRs being delivered and all requirements planned for delivery in accordance to the Build Plan, have been verified.

4. Verify that the configuration of the software is consistent with the documented description-the CMO will document the makeup of each FSW load image, specifying the version number of the different FSW subsystems comprising the load image. Configuration integrity will also be verified as indicated in section 7.2 (Configuration Authentication).

5. Ensure the integrity of the baselines is protected (e.g., only the CMO is authorized to build the release tree; the tree is write-protected from all other users).

6. Audit results will be recorded in the VDD, and resulting action items will be tracked to closure in the MKS Action Items database.

7.1 REPORTS AND RECORDS

The reports and records presented in Section 6.1 of this document shall be used in conducting the audits.

7.2 CONFIGURATION AUTHENTICATION

Three procedures shall be used to authenticate version integrity; i.e., ensure that actual computer code delivered is the same code that was tested and verified:

- Data Checks - code checksums shall be generated prior to test and verified for each version.

- Regression Tests - tests used for previous versions shall be performed on new versions to verify that already tested functions perform correctly with a new version.

- Version Construction Traceability - backups of released system versions shall be compared to resubmitted versions to identify differences.

8.0 CONFIGURATION MANAGEMENT RESOURCES AND TOOLS

8.1 SOFTWARE SUPPORT

This section provides a brief introduction to the configuration management resources and tools that shall be utilized by the [Mission Acronym] FSW Team. With the priorities of cost effectiveness and quality management, more companies have begun offering stand-alone configuration management tools. A brief summary of the tools chosen by the [Mission Acronym] FSW Team is provided in the subsections that follow. Finally, training in the use of these tools is also addressed in the final subsection.

8.1.1 Tools

The [Mission Acronym] FSW CM organization shall use an integrated system for CM and Discrepancy or Change Request/tracking, based on a tailored Commercial Off-The-Shelf (COTS) product ([CM Tool Suite name]). This system shall also provide status data and reports. The CM/DCR functions and interfaces are described in the FSW Configuration Management Procedures document.

The detailed description of the processes that implement the Tool(s) specifications (e.g., fields to be entered by the Developer, PDL, Test Lead and Testers; information regarding email notification; permissions on each Action; History and Log of the DCR process; build process; release process) as well as the CM/DCR functions and interfaces shall be described in the [Mission Acronym] CM Procedures document. This document shall serve as a user's guide for the tailored DCR/CM system as implemented.

8.1.2 Backup and Recovery

The CMO shall establish a recovery library in a secondary repository, physically separated from the FSW Development Library and computer operations. Additionally, the backup repository shall be located in a separate building from the FSW Library.

Server backups of the FSW Library, both incremental and full, shall be performed by the CMO on a routine basis. Incremental backups shall be performed daily and full backups shall be performed weekly. Restore operations will be tested periodically.

The procedures associated with backup and restoration of the FSW library shall be detailed in the [Mission Acronym] CM Procedures document.

8.2 TRAINING

This Section provides a brief discussion of the training that shall be provided to the CMO, the DTE, the Librarian, and others in the use of the tools that [Mission Acronym] has chosen to implement its Configuration Management functions.

[Use the following two subsections as guidelines for describing the plan for training team personnel in the tool suite to be used for Flight Software CM.]

8.2.1 Configuration Management Officer Training

[Tailor the following example paragraph to accurately describe the plan for CMO CM training.]

Formal training in customization, administration, maintenance and use of the [insert CM tool suite name(s)] CM tools shall be provided to the CMO. The courses shall be presented by the tool suite vendor, [tool suite vendor name, if applicable].

8.2.2 Development and Test Engineer and Librarian Training

[Tailor the following paragraph to accurately describe the plan for providing CM training to team personnel other than the CMO. The following paragraph describes training applicable to Development and Test Engineers and the Librarian, but add or subtract personnel and edit the training requirements as necessary. List any anticipated problems and solutions.]

Formal training in the use of the [CM tool suite name] shall be provided to the Development and Test Engineers. The course shall be presented by the tool suite vendor, [CM tool suite vendor name], during [XXX quarter YYYY – specify approximate timing of training, if possible].

APPENDIX A - ACRONYMS AND ABBREVIATIONS

ACS ..... Attitude Control System
APID ..... Application Process Identifier
ASIST ..... Advanced Spacecraft Integration and System Test
C&DH ..... Control & Data Handling (Subsystem)
CCB ..... Configuration Control Board
CM ..... Configuration Management
CMO ..... Configuration Management Officer
CMP ..... Configuration Management Plan
CMS ..... Configuration Management System
COTS ..... Commercial Off-The-Shelf
DCR ..... Discrepancy or Change Request
FCA ..... Functional Configuration Audit
FSB ..... Flight Software Branch (Code 582)
FSW ..... Flight Software
GNC ..... Guidance, Navigation and Control
GNCC ..... Guidance, Navigation and Control Center (Code 570)
GOTS ..... Government Off-The-Shelf
GPG ..... Goddard Procedures and Guidelines
GSE ..... Ground Support Equipment
H&S ..... Health & Safety
I&T ..... Integration & Test
ID ..... Identifier
IPDT ..... Integrated Product Development Team
IRB ..... Internal Review Board
IRD ..... Interface Requirements Document
ISC ..... Information Systems Center (Code 580)
NCR ..... Non-Conformance Report
NCR/CAS ..... Non-Conformance Reporting and Corrective Action System
PCA ..... Physical Configuration Audit
PDL ..... Product Development Lead
SSC ..... Support Service Contractor
STOL ..... Spacecraft Test and Operations Language
TBD ..... To Be Determined
VDD ..... Version Description Document
VDF ..... Version Description File

APPENDIX B - WAIVER LIST

This waiver page is to be used to document any content deviation from the Code 582 CM Plan template. All deviation requests must be submitted to the Product Development Lead (PDL) who will bring them before the appropriate board (Code 582 Standards CCB) for approval.

Waiver Description	Reason	Request Date	Date Approved	Approved By
[Brief Description of Deviation – include document paragraph reference]	[Reason for requesting waiver]	[Date waiver request is filed]	[Date waiver is approved]	[Approving Organization]